

# CEPHALOCHORDATA

## **INTRODUCTION**

Cephalochordates occur worldwide in warm temperate and tropical seas. Fish-like Acrania with characteristic chordate pattern that includes pharyngeal slits, tubular nerve cord, notochord, and postanal tail. The pharynx is large and sac-like perforated by numerous gill-slits. There is a prominent endostyle and a definitely ciliated tract answering the ciliary feeding habit. The gill-slits open into the atrium. There is a definite coelom. Metamerism is well marked. Excretion takes place through definite nephridia.

## **HABITAT**

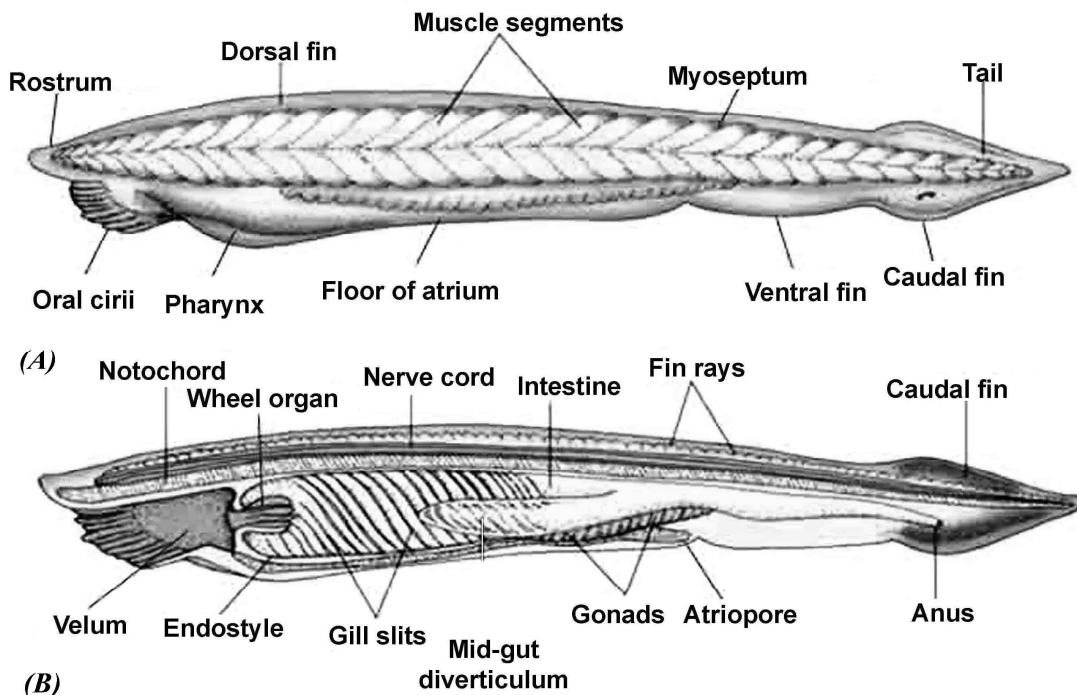
It is found in the shore water and on the sandy beaches of the temperate subtropical and tropical portions of the world. *Amphioxus* is essentially a burrowing animal. Though none of its features is connected with burrowing life, it burrows rapidly head first, in the sand by means of vibratory action of the entire body, but comes in rest with anterior end exposed to the water. It rests with head protruding and mouth wide a gape. It is also able to swim freely in water by means of lateral strokes of the posterior-portion of the body. It leaves the burrow particularly at night and during breeding season.

## **EXTERNAL FEATURES**

*Amphioxus lanceolatus* is about two inches long (sometimes attaining a length of about 3 inches), fish-like creature, semitransparent appearance showing iridescent play of colour. The body is narrow, laterally compressed and pointed at both ends. The back of the body is occupied by a crest, the dorsal fin, consisting of a hollow ridge. The dorsal fin is continued round both extremities. Anteriorly it forms the

expanded rostral fin and the caudal fin posteriorly. The ventral fin extends between the anus and atriopore.

The body of *Amphioxus lanceolatus* is divided to main four regions: Cephalic, atrial, abdominal and caudal regions



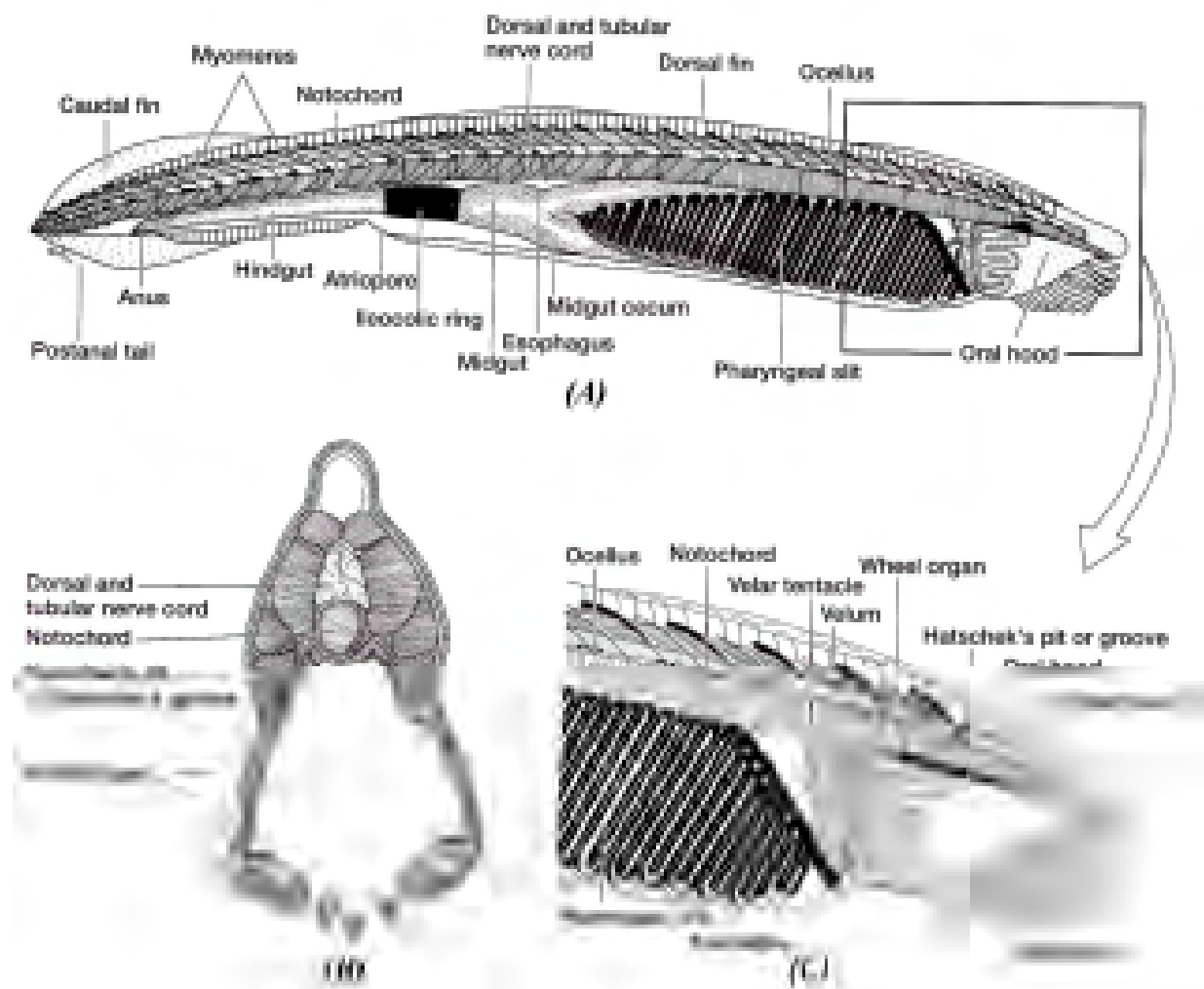
**External features and lateral view of *Amphioxus*.**

## CEPHALIC REGION

The cephalic region includes the rostrum or preoral lobe and mouth. The notochord extends beyond the mouth up to the tip of the rostrum. The **mouth** consists of two portions an outer **vestibule** and an inner **oral aperture**, which is surrounded by a sphincter with tentacles called the **velum**. The vestibule of the mouth is the space bounded by the **oral hood**. The lid-like growth around the true oral aperture grows larger and downwards enclosing this space. This is fringed with tentacle-like sensory processes the **buccal cirri**, each of which is supported by a solid skeletal axis. The oral hood with its cirri has a special nerve supply and musculature by which the cirri can be either spread out or bent inwards. The underside of the oral hood bears a complicated series of ciliated

grooves and ridges collectively known to form the **wheel organ**, because it sets up whirling currents of water. Between the ciliated lobes of the wheel organ towards the right hand side of the notochord there is a glandular groove which secretes mucous to help collecting food. This is called **Hatschek's groove or pit**. Hatschek's pit occurs in the roof of the buccal cavity, a similarity shared with the vertebrate pituitary gland, part of which also forms by invagination from the roof of the buccal cavity. This has led some to propose that Hatschek's pit has an endocrine (hormone-secreting) function

## ATRIAL REGION



A. Lateral view of Amphioxus B. T.S in anterior Oral hood region C. Enlarged dissected anterior region.

The atrial region extends from the mouth over about two-thirds of the length of the body, terminating at a large median aperture, the **atriopore**. It is an aperture for the exit of the respiratory current of water and also serves for the release of reproductive products. The ventral side of the body in the atrial region is broadened convex so that the body presents a somewhat triangular appearance, the dorsal fin forming the apex and the angles bordered by two hollow folds, the **metapleural folds**. Within each metapleural fold lies a continuous longitudinal **lymph space**, the metapleural canal. In *Amphioxus*, the metapleural folds terminate symmetrically behind the atriopore, but in some *Asymmetron* the right metapleural passes uninterruptedly into the ventral fin.

## ABDOMINAL REGION

The abdominal region comprises a short stretch of body between atriopore and anus, the termination of the alimentary canal. It is characterized by the presence of a special **ventral fin** (preanal fin) which is composed of two portions, a lower keel-like portion lying below an upper chambered portion, each chamber containing typically a pair of gelatinous fin-rays.

## CAUDAL REGION

The caudal region includes the post-anal division of the trunk. The keel of the **ventral fin** is continued past the anus into the expanded caudal fin, and so it happens that the anal opening is displaced from the middle line to the left side of the fin. In *Asymmetron* the caudal region is remarkable for the curious elongation of the notochord, which is produced far beyond the last of the myotomes.

## MUSCULATURE

The musculature which forms the greater part of the body wall is made up of about **sixty pairs** of segmentally arranged muscle segments or blocks, the myotomes. The myotomes do not run straight down the body in dorso-ventral direction, but are V-shaped the vertices of 'V' being directed anteriorly. Each muscle block is enclosed in a complete box of connective tissue. The anterior and posterior connective tissue walls are referred to as **myocommata**. The inner connective tissue walls lie just before the parietal layer of peritoneum. The olfactory pit, if present, is situated on the first muscle somite. These myotomes enable it to swim rapidly with characteristic serpentine undulations of the body. The movements are brought about by the alternate contraction and relaxation of the muscles on both the sides.

## DIGESTIVE SYSTEM

The alimentary canals a perfectly straight tube lined through out by ciliated epithelium. It begins at the **mouth** which is situated the base of the buccal funnel. The mouth itself is guarded by a ring or sphincter muscles bearing numerous slender sensory **velar tentacles**, which normally project backwards into the **pharynx**. The **velum** leads into a wide chamber, the **pharynx** or branchial sac, where the main operation of food collection is performed. The pharynx is flattened from side to side and possesses a large number (about 200) of oblique vertical slits, **the gill clefts**. The number of gill clefts increases with age.

In the floor of the pharynx lies the **endostyle** comprising **four columns of mucous-secreting cells** that produce sticky threads in which food particles become entangled. On the dorsal surface of the pharynx there is a median **epipharyngeal groove** which also assists in food catching. Behind the velum lie certain ciliated peripharyngeal tracts,

which divert the food particles captured by the sticky threads of the endostyle to the epipharyngeal groove in which they are conducted backwards to the mid-gut. *Amphioxus* is surrounded by a large water-filled chamber called the **atrium** and the peripharyngeal cavity opens to the exterior by a small posteriorly directed aperture called the atriopore. The atrium is lined by ectoderm, for it arises as long ectodermal folds of the body wall called the **metapleural folds**.

The pharynx projects freely into the atrium being surrounded by the continuous atrial cavity at the sides and below. The pharynx opens behind into the **mid-gut** which narrows posteriorly and gives a ventral **diverticulum**, often called **liver**. It lies rather to the right side of the pharynx, and secretes digestive enzymes

The mid-gut runs straight posteriorly as the hind-gut or **intestine** and opens at the **anus**. The hind end of the mid-gut is marked by especially ciliated region, the **ilio-colon** ring whose cilia rotate the food and mucous as it passes. In the mid-gut extra cellular digestion takes place. Absorption takes place in the intestine and partly also in the mid-gut, probably by **intra-cellular digestion**. The faeces is discharged through the anus.

## **SKELETAL SYSTEM**

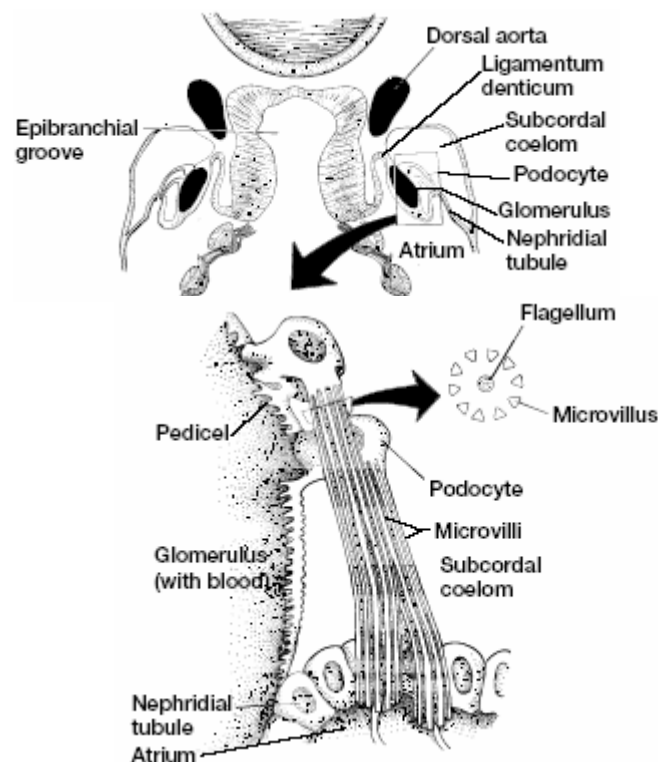
Firstly, the **notochord** of *Amphioxus* extends from the very tip of the head to the end of the tail, projecting beyond the level of myotomes. It is surrounded by a thick fibrous non-cellular sheath, the notochordal sheath. The notochord proper consists of large vacuolated cells filled with fluid. Secondly, the oral hood is supported by a thin ring of **cartilage**, the cartilaginous loop, around its edges which protects the opening from collapse. Similar skeletal rods also occur in the cirri and articulate with the cartilaginous loop in the oral hood. Thirdly, the gill slits are supported

by diagonally sloping skeletal rods called **gill-bars**. Fourthly, the **fin rays** median ridges contain boxes made up of connective tissue, each of which contains a gelatinous substance. The dorsal fin has a single row of such boxes, whilst the ventral has a double.

## EXCRETORY SYSTEM

The excretory system of amphioxus consists of **paired nephridia** opening into the **atrium** via a nephridial tubule and an **unpaired Hatschek's nephridium** opening into the **buccal cavity**. The paired nephridia arise from mesodermal cells, unlike those in most coelomate invertebrates, where they are derived from ectodermal cells.

A nephridium consists of clusters of **podocytes**. Each podocyte is a single cell with cytoplasmic **pedicels**, projections that contact the nearby **glomerulus**, connected to the dorsal aorta. From the other side of the podocyte, a long circular strand of **microvilli**, with a single long **flagellum** down the center, projects across the coelomic space to enter the nephridial tubule. Each nephridial tubule receives a cluster of podocytes and in turn opens into the atrium.



## CIRCULATORY SYSTEM

The circulatory system of *Amphioxus* has **no heart** and the blood contains neither haemoglobin nor other respiratory pigment. The circulation is brought about by slow waves of contraction that pass along the major arterial vessels in such a way that the blood is driven forwards in the ventral vessel and backwards in the dorsal.

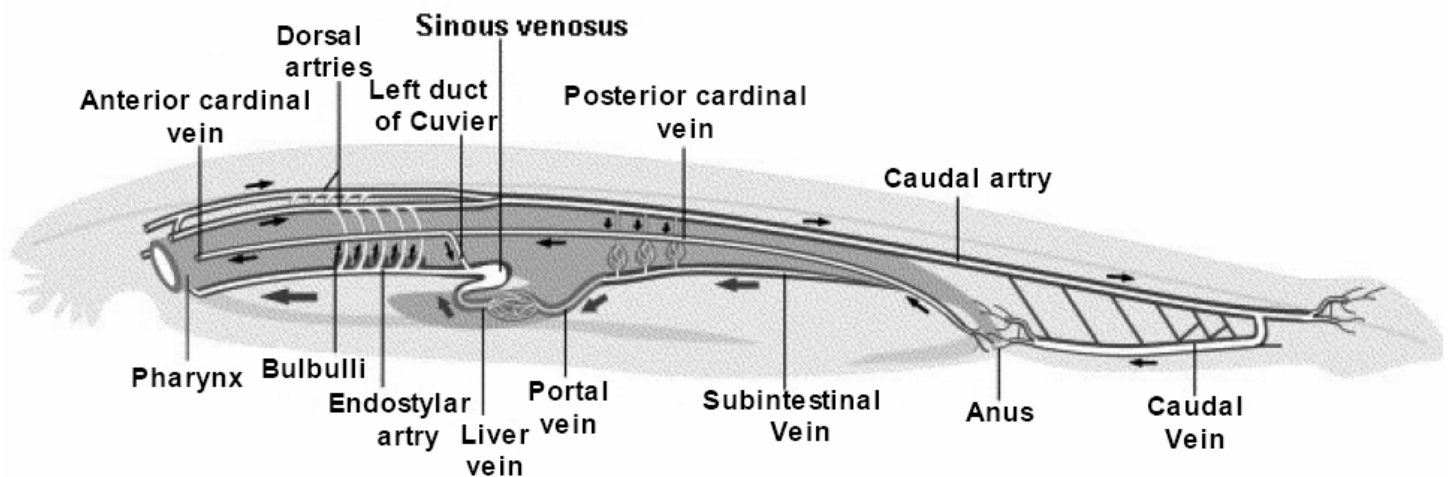
Just below the hinder end of the pharynx lies a large sac, the **sinus venosus**, that receives blood from all parts of the body. From this arises a large branchial artery, the **ventral aorta** (truncus arteriosus) and proceeds forwards in the ventral wall of the pharynx below the endostyle. It is contractile and drives the blood forwards. From the ventral aorta spring several vessels, the **afferent branchial arteries**, on each side with small contractile dilations at their bases, presumably acting as branchial heart

The afferent vessels pass up the primary branchial lamellae and communicate by cross branches with similar vessels in secondaries or tongue lamellae. While traversing these vessels the blood is exposed to the aerating influence of the respiratory current and leaves the branchial lamellae dorsally by **efferent branchial arteries**, which on each side, open into paired longitudinal vessels the right and left dorsal aortae, lying one on either side of the epipharyngeal groove. Anteriorly both the aortae are continued forward to rostral region and posteriorly forming single **dorsal aorta**.

The venous system is represented by **cardinals**, caudal and plexus of the gut. There are two pairs of cardinals, the anterior cardinals and the posterior cardinals, running in the dorsal wall of the coelom, collecting blood from the muscles and body wall. They open into the sinus venosus

by a pair of vessels, **ductus Cuvieri**, which pass ventrally and across the coelom to join the sinus venosus on the floor of the gut.

The caudal veins join the plexus on the gut from which blood is collected by a large median **subintestinal vein** running on to the liver. The blood in this flows forward and at the origin of the liver it passes insensibly into a **hepatic portal vein**, which extends along the ventral side of the liver and breaks up into capillaries in that organ. From the liver blood makes its way into a hepatic vein which extends along the dorsal side of the digestive gland and turning downwards and forwards joins the sinus venosus.



**Diagram of arterial and venous blood flow of Amphioxus.**

## NERVOUS SYSTEM

The nervous system consists of a central nervous system, which is hollow, tubular situated on the dorsal side of the notochord, and fine nerves arise from it forming the peripheral nervous system. The nerve cord is like that of other vertebrates but it tapers anteriorly and is broad at the posterior end.

The nerves connected to the periphery arise by two simple sets of nerve roots, a dorsal and a ventral but the roots do not join. The ventral roots lie opposite the myotomes, to which they carry motor (or efferent) fibres, and these end on the muscle fibres with motor end-plates as found in the vertebrates. The dorsal root runs out between the myotomes and carries all the sensory (or afferent) fibres of the segment and motor fibres of the non-myotomal muscles of the ventral part of the body. As in vertebrates there are motor nerve cells forming a plexus in the gut wall. The fibres of the peripheral nerves differ from those of vertebrates in that they have no thick myelin sheath. The sensory fibres are more like the neuro-sensory cells of the invertebrates. The cell bodies are not collected into spinal ganglia but lie either close below the epidermis or scattered along the course. The spinal cord has a narrow lumen and its elements are arranged as in other vertebrates

## INFUNDIBULAR REGION

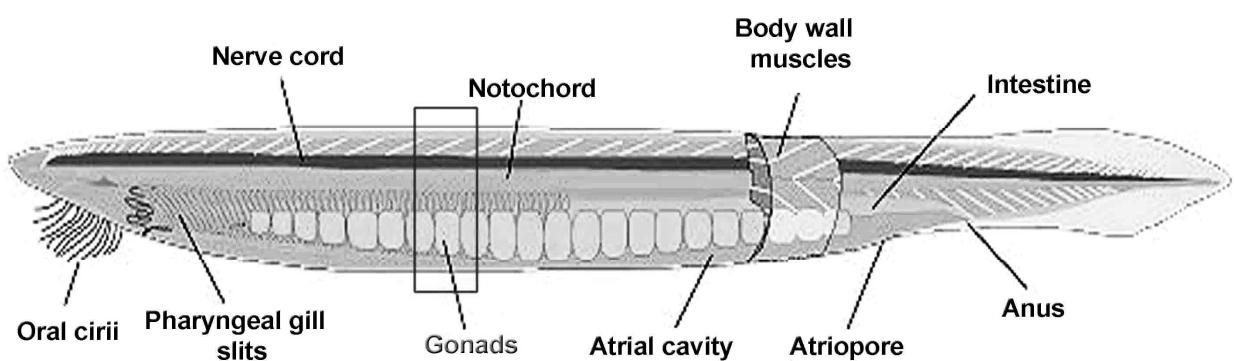
Gravity or pressure receptor, is situated in the wall of the cerebral vesicle. It is composed of tall cells with long cilia that beat in opposite direction to those of the rest of the vesicle. The **Kolliker's** pit (the so-called Olfactory pit), presumably a chemoreceptor, is situated at the anterior end of the nerve cord. The tentacles and oral hood are also provided with chemoreceptors, usually grouped in papillae on the oral cirri and on the velar tentacles.

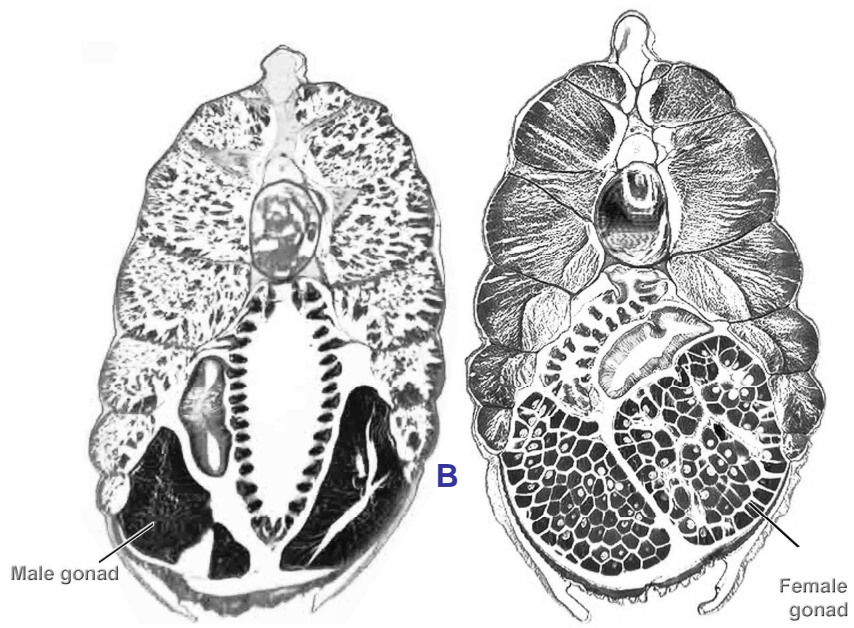
## PHOTORECEPTORS

Certain photoreceptors occur along the walls of the central canal of the neural tube and in definite lateral tracts. In the anterior third of the body they are also found in the ventral wall of the neural tube. They occur along the whole length of the neural tube. These pigmented photoreceptors have been called **eye spots** or **simple eyes**, and resemble those of the planarians. Each eye-spot consists of a single large cell bearing a cap of blackish-brown pigment in a cup-shaped area to one side of the cell. Between the pigment cup and the nucleus the cytoplasm is differentiated to form a striated layer which probably acts like a lens. A single nerve fibre leaves the cell on the side opposite to that bearing the pigment cup.

## REPRODUCTIVE SYSTEM

The sexes are separate; the gonads of *Amphioxus* are hollow sacs laying in the anterior two-third of the body on the ventral side. They are arranged strictly metamerically, one pair in each of the segments twenty-five to fifty one (**26 pairs**). The gonads are without ducts. When mature the overlying tissue ruptures allowing the release of the sex cells in the atrium, whence they pass out through the atriopore. The fertilization is external and gives rise to larval stage that undergoes metamorphosis (Lancelet larva)





**A. Figure showing position of gonads in atrial region on both sides of pharynx. B. T.S in pharyngeal region showing male and female gonads.**

# CYCLOSTOMATA

## *PETROMYZON FLUVIATILIS*

### (THE LAMPREY)

## INTRODUCTION

The earliest craniates lacked jaws, and so are termed “agnathans.” Numerous extinct “agnathans” are known from the fossil record and most possessed a covering armor of dermal bone, from which is derived the term “ostracoderms.” Living craniates retaining the absence of jaws are the hagfishes (Myxinoidea) and lampreys (Petromyzontoidea). A characteristic feature of these craniates is an anterior, rounded, sucker-like structure used to attach themselves to the body of their prey, from which the term “cyclostome” is derived.

Lampreys are generally parasitic, attaching themselves to their prey and relying mainly on a liquid diet, while hagfishes are scavengers and tear off pieces of dead or dying prey. The lamprey, for example, has a subdivided pharynx, with the ventral part forming a respiratory tube that can be isolated from the mouth by a valve termed the velum. This ensures that its liquid diet neither escapes from the pharyngeal slits nor interferes with gas exchange through the gills. While the tube is isolated, the lamprey continues to ventilate its gills by pumping water in and out of the pharyngeal slits. The hagfish, on the other hand, has a more substantial diet and does not require a respiratory tube that can be isolated. It ventilates its gills by having a nasal opening that continues past the nasal sac to communicate with the pharynx. A velum is also present in the hagfish. With the velum closed, muscular action compresses the pharynx and water moves over the gills. Cyclostomes are usually marine in habitat although they frequent fresh water to breed.

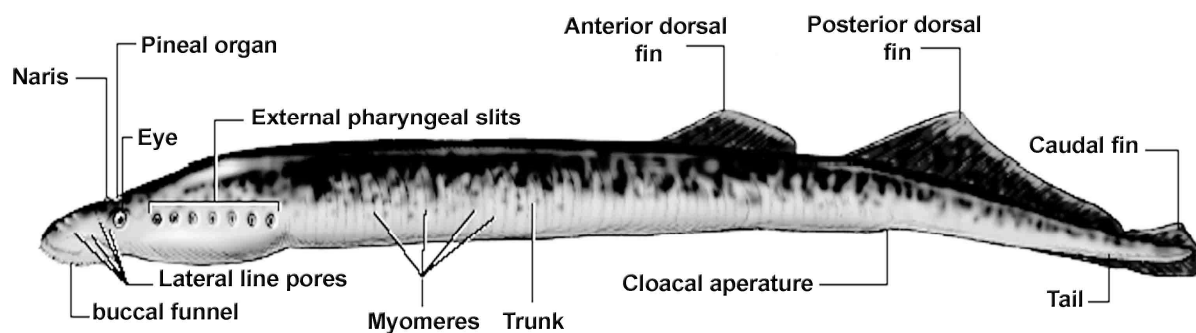
## **MAIN CHARACTERISTICS OF CYCLOSTOMATA**

- 1) The body is long, eel like. It shows head, trunk and compressed tail, the skin is slimy, soft and scaleless.
- 2) Paired fins are absent. Median fin is supported by cartilaginous fin-rays.
- 3) Z- shaped myomeres are present in the trunk and tail.
- 4) Jawless vertebrates, hence called Agnatha.
- 5) The mouth is circular. It works like a sucker. It is surrounded by tentacles and the tongue bears teeth.
- 6) Endoskeleton is present (cartilaginous), Skull is simple and primitive and notochord persists throughout life.
- 7) Vertebrae are represented by neural arches, around the notochord.
- 8) Five to sixteen pairs of gills are present in sac like pouches
- 17) Brain is developed and ten pairs or less number of cranial nerves are present.
- 9) Nasal sac is single and median and lateral line sense organ is present.
- 10) Excretory system includes a pair of mesonephric kidneys.
- 11) Sexes are separate and gonad is single and without a gonoduct.
- 12) Development may be direct or with a long larval stage.

## EXTERNAL FEATURES

The body of the lamprey is elongated and cylindrical, and covered by smooth, scaleless skin. The head extends posteriorly to include the slanted row of seven rounded or oval apertures, the external pharyngeal slits, which lie posterior to each of them laterally placed, lidless eyes. The eyes, of moderate size, are covered by transparent skin. In preservatives, however, this skin turns opaque.

Anteriorly the oral funnel forms a wide, sucking disk that attaches to the body of the lamprey's prey. The funnel's margin bears small, soft projections, the buccal papillae, which are primarily sensory structures. The funnel's interior surface is termed the oral disk, and it is lined with numerous horny teeth, which are cornified epidermal derivatives and thus not homologous with the teeth of more derived vertebrates. The tongue is used to abrade the skin of prey, so that its blood and body fluids may be ingested.



**External features of the lamprey in left lateral view.**

A single, median naris lies middorsally between the eyes. A lighter patch of skin immediately posterior to the nostril denotes the position of the pineal complex, which lies just below the skin and functions as a photoreceptor that detects changes in light. A lateral line system, which functions in detecting vibrations in the water, is present in the lamprey, but not typically conspicuous.

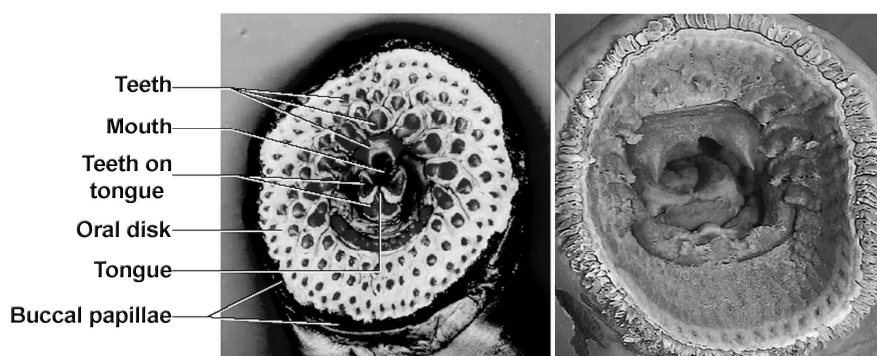
The trunk extends from the head to the cloaca, a rather shallow midventral depression. The intestine opens into the cloaca through a slit-like anus. Posterior to the latter, there is a small urogenital papilla with a terminal genital pore through which gametes and excretory products leave the body. The tail extends posteriorly to the tip of the body and becomes laterally compressed. The lamprey has no trace of paired fins, but there are three median fins, the anterior dorsal and posterior dorsal fins and the caudal fin. The fins are supported by fin rays.

## MUSCULATURE

The segmental musculature of cyclostomes presents the same generalized plan as in *Amphioxus*. Regular segmental myotomes or myomeres run uniformly from head to tail with no regional specializations except where they are interrupted by gill-slits and eyes. Between adjacent myotomes are myocommata, tough connective tissue partitions. On the back of the head each myotome is W-shaped instead of V-shaped as in *Amphioxus*.

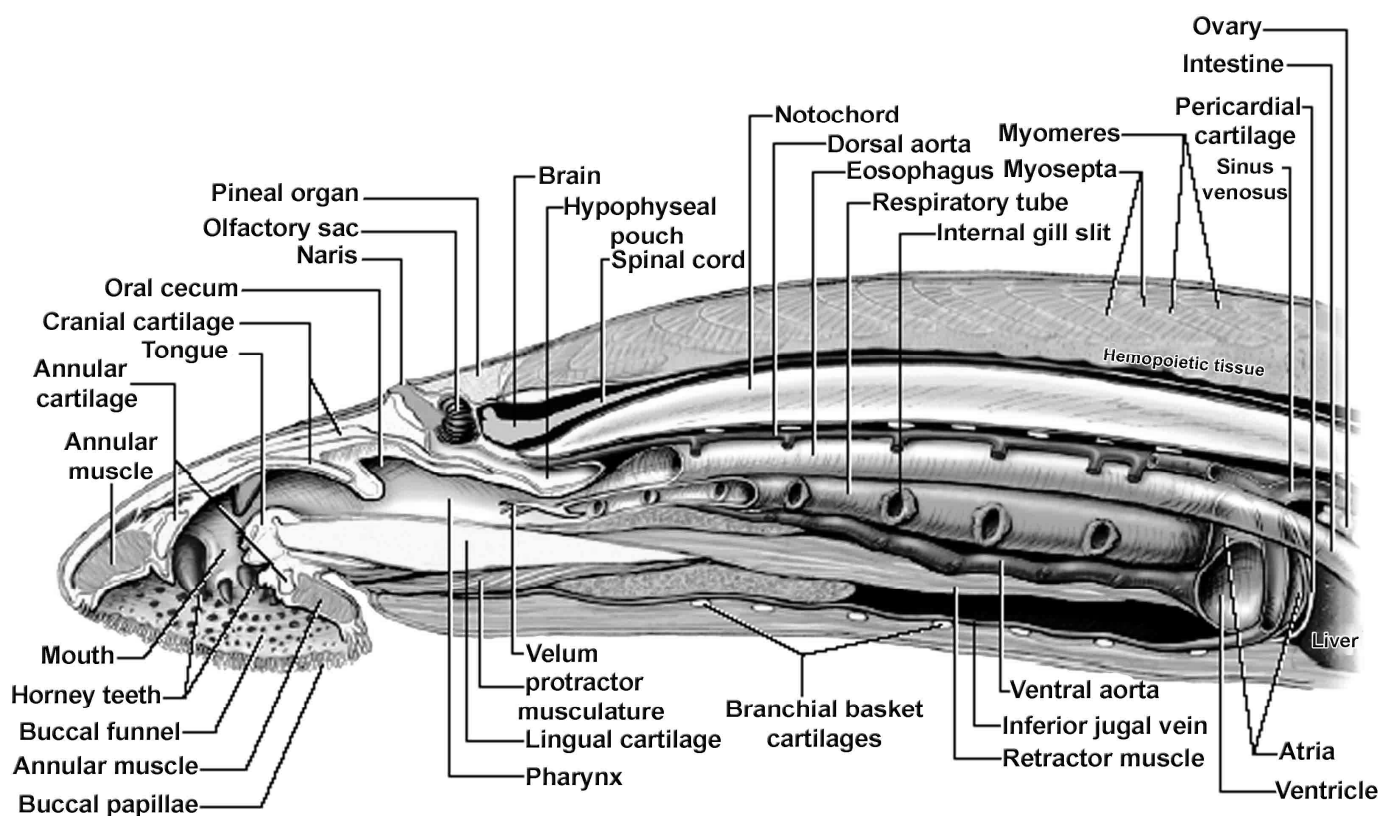
## DIGESTIVE SYSTEM

The **mouth** is at the centre of the **buccal funnel** or sucker. It is closed or opened by the forward or backward movement of the piston-like tongue. On the edges of the sucker occur a series of lips which are sensory, and make a tight attachment when the lamprey sucks. The mouth is surrounded by horny epidermal **teeth**, the arrangement of which varies in different types of lamprey. The sharper and large teeth occur on the movable tongue that is used as a rasp.



Surface view of buccal (oral) cavity of lamprey

The mouth leads into a large **buccel cavity** (also called **pharynx**). At the hinder end it divides into a dorsal food passage, the **oesophagus** and a ventral **respiratory tube**. The entrance of the respiratory tube is guarded by a **velum** bearing a series of velar tentacles presumably sensory. The oesophagus opens directly into the straight **intestine** as there is no true stomach in lamprey. The surface of the intestine is increased by a **typhlosole** (spiral valve) running in a spiral fashion. The intestine ends at the small anus. There are **salivary gland**, each of which has a folded wall and gives out a duct that opens below the tongue. The secretion of these prevents coagulation of the blood of the fish on which the lamprey feeds. The **liver** is the large, located at the anterior end of the pleuroperitoneal cavity. A **gall bladder** and bile duct are present in the larval stage, but absent in adult lampreys. In addition, the **spleen** is absent, as is a distinct **pancreas**. Tissue performing pancreatic functions is present, however, and scattered through some viscera. Exocrine pancreas is present in parts of the intestinal wall and islet tissue (endocrine) occurs in the liver, but they are not visible grossly.

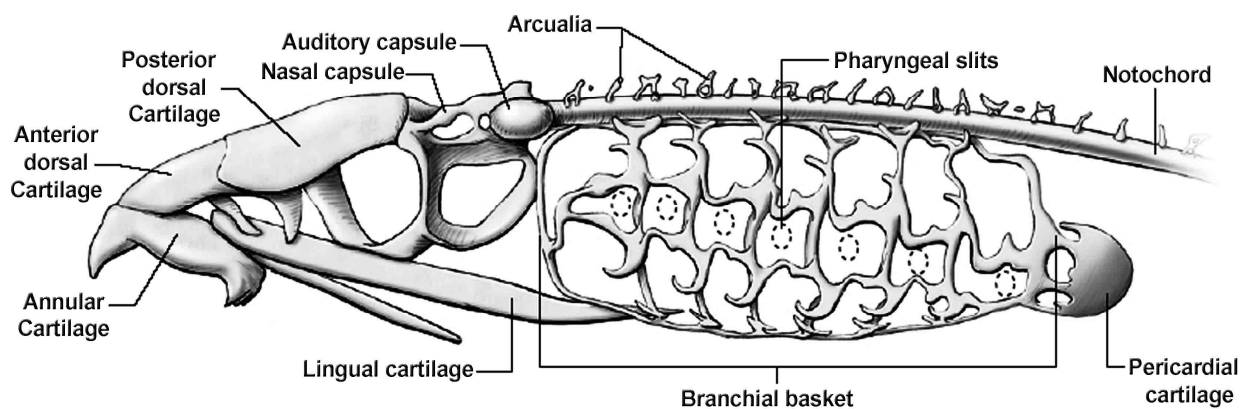




**Cross section in adult lamprey in region of intestine,  
liver and kidney**

## SKELETAL SYSTEM

The entirely cartilaginous skeleton of the lamprey is not particularly well developed. Endochondral elements forming a chondrocranium include large cartilages that partially enclose the brain and sense organs (nasal capsule, otic capsule), and others that extend anteriorly to support the **annular cartilage**, the ring-like structure that is the main skeletal element of the oral funnel. The median **lingual cartilage**, supporting the rasping tongue, extends posteriorly from the annular cartilage, ventral to the chondrocranium. Extending posterior and connected to the chondrocranium is a network of cartilages forming the **branchial basket**, which supports the pharyngeal region. The somewhat hemispherical cartilage at the posterior end of the branchial basket is the **pericardial cartilage**, which lies on the posterior wall of the pericardial cavity, the space that contains the heart.



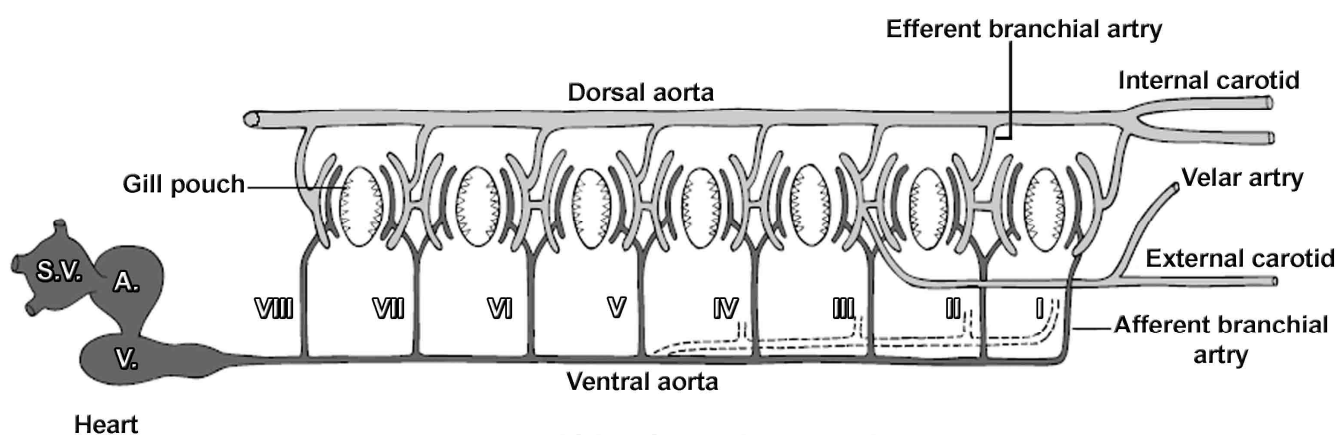
**Skeletal elements of lamprey in left lateral view.**

The large **notochord** is the axial support of the body. It is an elongated rod extending from beneath the posterior half of the brain to the tip of the tail. The vertebrae are represented by small, cartilaginous structures, termed **arcualia**, that lie dorsal to the notochord on either side of the spinal cord.

## CIRCULATORY SYSTEM

The circulatory system of the lamprey is of the same type as that of *Amphioxus*, but a definite **heart** has developed. The heart lies in the pericardial cavity, posterior to the respiratory tube. Posteriorly it is separated from the pleuroperitoneal cavity by the transverse septum, which is stiffened by the pericardial cartilage. The heart has **three chambers**, in contrast to the four present in more derived vertebrates. These are, in order of blood flow, the sinus venosus, atrium, and ventricle. Contractions proceed from behind forwards. The sinus venosus receives blood from veins and conducts it to the auricle. The thick walled ventricle pumps it round the body.

The blood leaves the heart by the ventral aorta, running forwards and giving off a series of eight pairs of **afferent branchial arteries** to the gills where aeration takes place and then it is collected in a median dorsal aorta that carries blood to all the parts of the body through a series of segmental arteries and special vessels to the gut, gonads and excretory organ.



**Arterial blood circulation of lamprey**

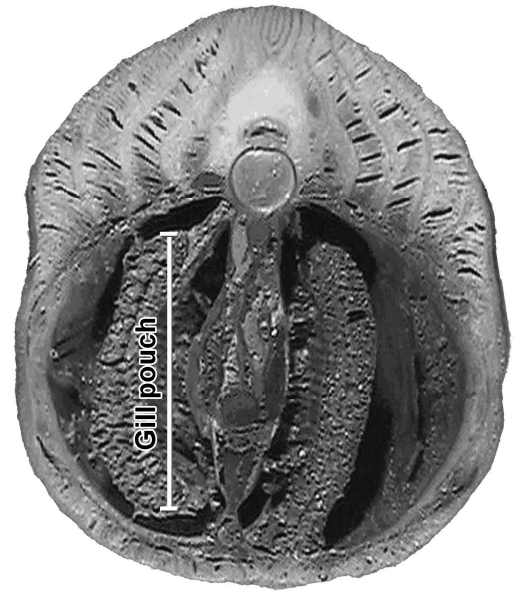
The venous system presents simple vertebrate plan. A single caudal vein collecting blood from the tail divides into two **posterior cardinals** on entering the abdomen. These receive blood from the kidneys and

gonads, etc., and open into the heart by a single ductus Cuvieri on the right hand side. Anterior cardinals collect blood from anterior side of the body.

A **hepatic portal vein** collecting blood from the alimentary canal is present. There is no **renal portal system**. Lymphatic vessels are also present. The blood contains the respiratory pigment within nucleated corpuscles, white corpuscles also occur. The **spleen** is absent; therefore, it is believed that the corpuscles are produced in lymphoid tissue in the kidneys and elsewhere.

## Respiratory system

There are seven pairs of obliquely placed **gill-pouches** between the respiratory tube and the body wall. Each gill-pouch contains many gill-filaments with fine capillaries in which aeration actually takes place. Water enters the pouches through the same opening through which it comes out. It is not so in fishes. The reason for this peculiarity is that the lamprey attaches to its prey or other objects by its buccal funnel, as such water cannot enter through the mouth. In the larval stages the normal course exists, that is, water enters through the mouth and comes out of the gill openings as in fishes.

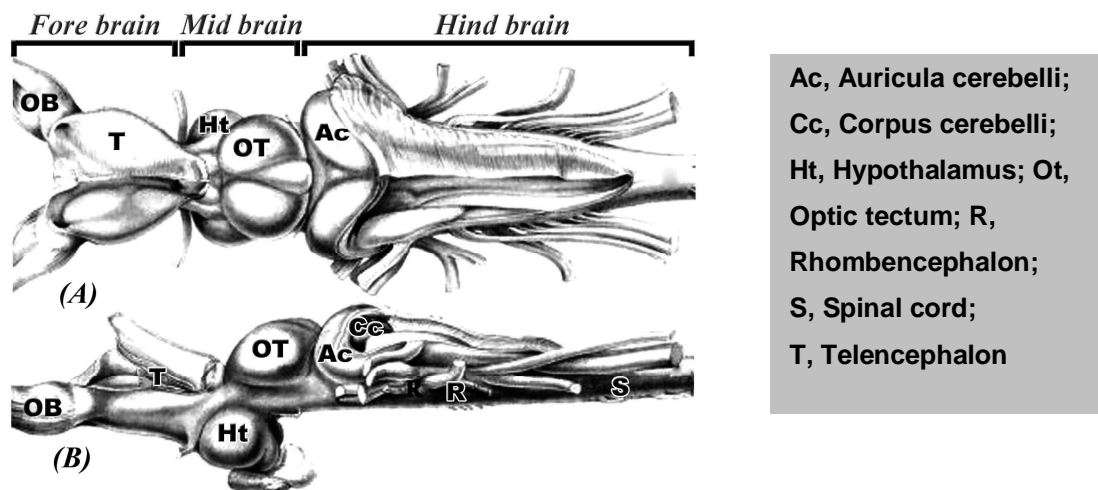


Cross section in pharyngeal region  
of lamprey showing gill pouches

## NERVOUS SYSTEM

The nervous system shows an advance over that of *Amphioxus* and presents vertebrate plan. The forebrain includes large paired **olfactory lobes**. The **cerebral hemispheres** are small attached to the **diencephalon**. Beneath the latter lies a broad infundibulum and the pineal or **median eye** dorsally. The **midbrain** has a pair of large **optic lobes** rather dorsally placed. The **hindbrain** is differentiated into a small transverse dorsal band, the **cerebellum**, and a much larger ventral **medulla oblongata**. Between the optic lobes and the medulla extends anterior choroid plexus containing rich blood supply. The spaces or ventricles within the brain are four as in other vertebrates. The cranial nerves are 10 pairs.

The spinal cord is dorso-ventrally flattened and band-like structure of uniform transparent grey colour. The spinal nerves are like those of *Amphioxus* in that the dorsal and ventral roots do not join. In *Amphioxus* the dorsal roots contain sensory fibres and motor-fibres for the lateral plate musculature, while the ventral roots only motor fibres.



Dorsal (A) and lateral (B) view of brain of lamprey.

## SENSE ORGANS

The single **nasal aperture** leads into an olfactory sac innervated by nerve endings from both the olfactory lobes of the brain. The paired **eyes** present the same structure as is found in a normal vertebrate eye. The eyes are formed as a result of evaginations of the wall of diencephalon, the optic nerve, therefore, is not a nerve but a portion of the brain. There are six extrinsic muscles controlling the movement of each eye. On the other hand, there is a cornealis muscle pulling on the cornea

The **pineal or epiphysial eye** presents an elaborate eye-like structure with a clear lens and pigmented retina. The **lateral line sense organs** are peculiar to fish-like vertebrates. They occur in the lamprey on the sides of the body and the under surface of the body. Each is a little patch of sensory cells innervated by fibres from cranial nerves, those on

the trunk and the tail getting fibres from a special branch of the vagus nerve

The **auditory sacs** are formed as a result of the inpushing of the wall of the head which ultimately becomes cut off from the exterior. As a result of complications the sac is divided into several chambers. The sacculus and utriculus are two pockets to which are connected two tubes, the semicircular canals, set at right angle to each other. They are organs that help the animal to maintain equilibrium. **Taste buds** occur in the pharynx; and there are light sensitive cells (**photoreceptors**) in the skin as well as in the eyes. They are numerous in tail and if the tail is exposed to light the animal moves away quickly.

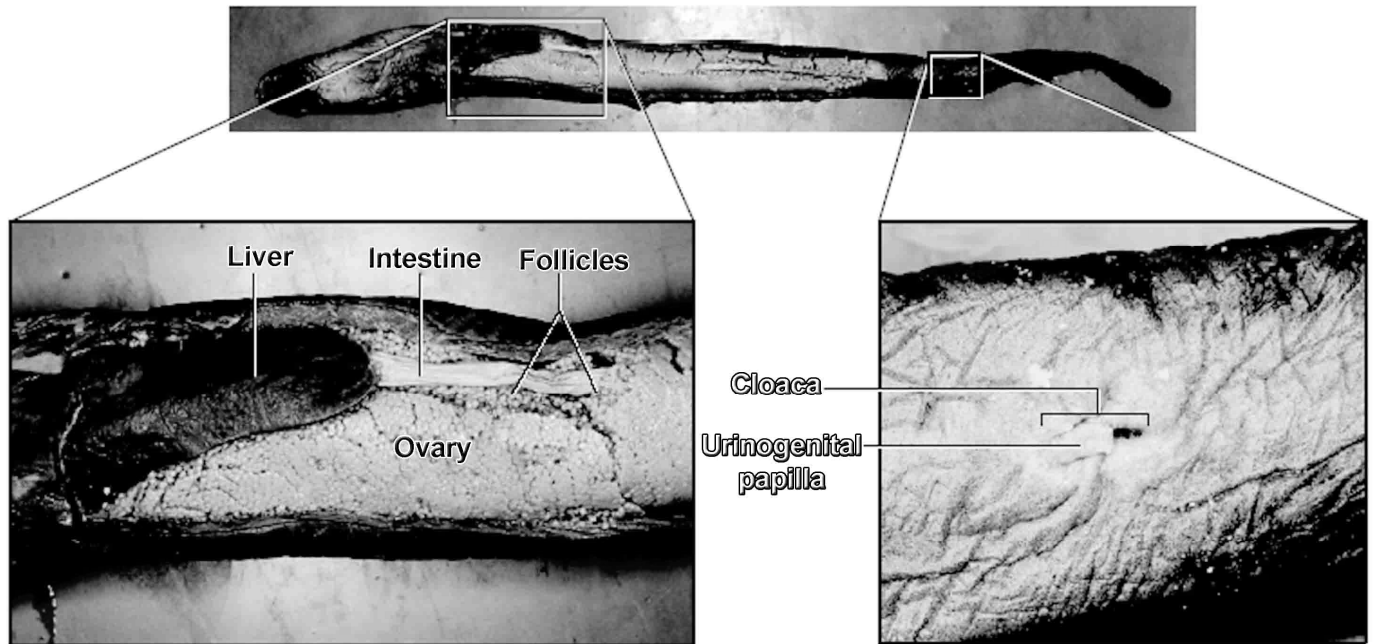
## GENITAL SYSTEM

The urinary system includes two kidneys (mesonephros) which lie dorsally in the body cavity. From each arises a tubular ureter and runs to the urinogenital sinus which opens to the exterior on the urinogenital papilla. The gonads develop from ridges of tissue lying medial to the mesonephros on each side.

The differentiation of the gonad takes place quite late in life, as such in the young lamprey the organ contains developing oocytes and spermatocytes together (hermaphrodite). But later on the gonad becomes either testis or ovary or that the sexes in the adults are separate (dioecious). The ripe ovary consists of ova, each surrounded by a single layered follicle. The testis consists of a number of follicles containing sperms. The sex cells escape through genital pores developed just before mating.

These pores are similar in the two sexes and consists of short channels, one on each side, leading from the coelom to the lower end of the kidney duct. Fertilization is external. The cloaca is differently

modified in two sexes to ensure fertilization and proper placing of the eggs. In mature male the lips of the cloaca unite to form a narrow tube



like penis. In the female the cloacal lips are enlarged and often red. The female also possesses the anal fin which probably helps in making a nest

**Ventral view with exposed pleuroperitoneal cavity of lamprey showing female gonads and cloacal region.**

## **AMMOCOET LARVA**

Ammocoete larva about 10 mm in size. This tiny creature is transparent. But it grows up into an opaque eel-like creature about 170 mm long. The larval life is relatively long from three perhaps to seven years. They live in burrows in the sand for three years or more before undergoing metamorphosis. The young lampreys then migrate down stream and out to sea.

Food is drawn in by the water current produced by the rhythmic movement of the gills, and appears to be drawn mainly from adjacent mud surface. The mucous food cord rotates in the current and passes

directly back to the oesophagus. The feeding mechanism of this type is found in larvacean and thaliacean tunicates. No enzymes have been discovered in the endostyle, its main function is to produce mucous.

On metamorphosis the endostyle develops into a thyroid gland. Nothing is known about the function of thyroid in the adult lamprey, it, however, presents the conversion of an externally secreting feeding organ into a gland of internal secretion. The mouth becomes rounded; teeth, tongue and complex musculature appear. The paired eyes come up, the olfactory organs mature. The hypophysial sac enlarges and extends back to the gills. The gills develop into sacs opening into the branchial chambers. Intestine become modified, yellow brown colour of the larva becomes dark.

